UNIVERSITI SAINS MALAYSIA

First Semester Examination
2012/2013 Academic Session

January 2013

EEE 228 – SIGNAL AND SYSTEM
[ISYARAT DAN SISTEM]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of THIRTEEN (13) pages including Appendices TWELVE (12) of printed material before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi TIGA BELAS (13) mukasurat beserta Lampiran DUA BELAS (12) muka surat bercetak sebelum anda memulakan peperiksaan ini.]

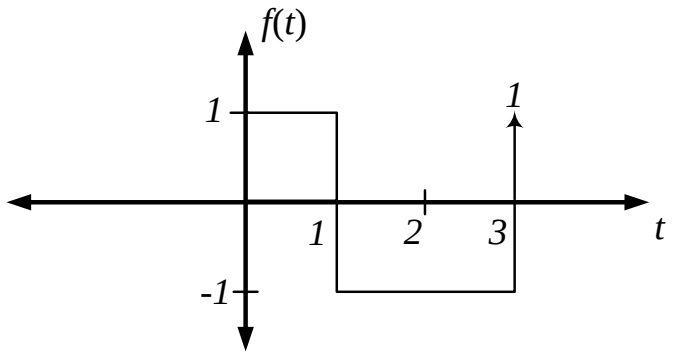
Instructions: This question paper consists SIX (6) questions. Answer **FIVE** (5) questions. All questions carry the same marks.
[***Arahan:*** *Kertas soalan ini mengandungi ENAM (6) soalan. Jawab **LIMA** (5) soalan. Semua soalan membawa jumlah markah yang sama.]*

Answer to any question must start on a new page.
[Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru]

In the event of any discrepancies, the English version shall be used.
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

…2/-

1. (a) Isyarat *f(t)* yang ditunjukkan dalam Rajah 1(a).
Signal f(t) is shown in Figure 1(a).



Rajah 1(a)
Figure 1(a)

(i) Tuliskan persamaan *f(t)* dari segi **fungsi langkah unit dan fungsi delta.**

Write the equation of f(t) in terms of ***unit step function and delta function.***

(15 markah/*marks*)

(ii) Cari dan lakarkan $\int_{-\infty}^{t} f(t-2)dt$ untuk isyarat *f(t)*.

Find and sketch $\int_{-\infty}^{t} f(t-2)dt$ *for the signal f(t.)*

Pembayang:
Hints:

$$\int_{-\infty}^{t} u(\tau)d\tau = r(t)$$

$$\frac{d}{dt}[u(t)] = \delta(t)$$

(25 markah/*marks*)

…3/-

(b) Tentukan sama ada isyarat $x[n] = (-1)^{n^2}$ adalah berkala. Jika isyarat *x[n]* berkala kemudian cari tempoh asas *x[n]*.

Determine the condition for the signal $x[n] = (-1)^{n^2}$ *to be periodic. If signal x[n] is periodic then find the fundamental period of x[n].*

(20 markah/*marks*)

(c) Tentukan samaada isyarat berikut adalah isyarat tenaga atau kuasa isyarat atau tidak kedua-duanya.

Determine whether the following signal is energy signal or power signal or neither.

$$x(t) = A \qquad \text{for } t < 0$$
$$= Ae^{-at} \qquad \text{for } t \geq 0$$

Where $a > 0$

(20 markah/*marks*)

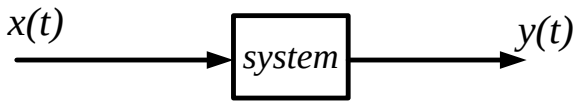
(d) Nilaikan kamiran berikut

Evaluate the following integral

$$\int_{-4}^{4} (t-2)^2 \delta'(2t-2)dt$$

(20 markah/*marks*)

2. (a)



Tentukan sifat-sifat berikut untuk sistem $y(t) = \cos(t+2)x(t-2)$

Determine the following properties for the system $y(t) = \cos(t+2)x(t-2)$

(i) punca

causality

(ii) ingatan

memory

(iii) masa-varians

time-variance

(30 markah/*marks*)

(b) Input *x*(*t*) dan sambutan dedenyut *h*(*t*) bagi sistem LTI berterusan diberikan oleh $x(t) = e^{-at}u(t)$, bagi $a > 0$ dan $h(t) = u(t)$. Apakah output, y (t)?

The input x(t) and the impulse response h(t) of a continuous LTI system are given by $x(t) = e^{-at}u(t)$, for $a > 0$ and $h(t) = u(t)$. *What is the output, y(t)?*

(30 markah/*marks*)

(c) Satu sistem adalah yang dinyatakan oleh persamaan pembezaan berikut
A system is described by the following differential equation

$$\frac{d^2y(t)}{dt^2}+3\frac{dx(t)}{dt}+2y(t)=\frac{dx(t)}{dt}-x(t)$$

Cari Impulse Sambutan *h*(*t*) bagi sistem

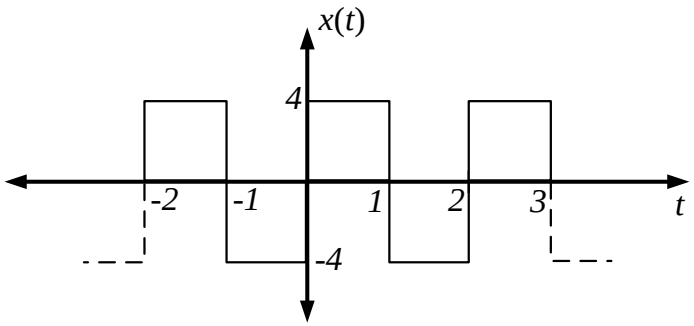
Find the Impulse Response h(t) of the system

(40 markah/*marks*)

3. (a) Cari eksponen siri Fourier bagi isyarat *x(t)* yang ditunjukkan dalam Rajah 3(a).

Find the exponential Fourier series for the signal x(t) shown in Figure 3(a).

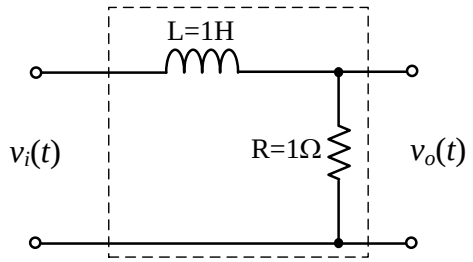
(40 markah/*marks*)



Rajah 3(a)
Figure 3(a)

(b) Cari voltan keluaran $v_o(t)$ litar yang ditunjukkan dalam Rajah 3(b) untuk voltan input berkala $v_i(t)$, di mana $v_i(t)= 4\cos(t) - 2\cos(2t)$

Find the output voltage $v_o(t)$ of the circuit shown in Figure 3(b) for a periodic input voltage $v_i(t)$, where $v_i(t)= 4\cos(t) - 2\cos(2t)$



Rajah 3(b)

Figure 3(b)

(40 markah/*marks*)

(c) Gunakan teorem Parseval untuk mencari jumlah kuasa isyarat berkala

Apply Parseval's theorem to find the amount of power of the periodic signal

$$x(t) = 3 + 5\cos(2t + 30°) + 2\cos(4t + 40°)$$

(20 markah/*marks*)

4. (a) Dengan menggunakan definisi Jelmaan Fourier, cari jelmaan Fourier bagi isyarat–isyarat berikut:

Using the definition of Fourier Transform, find the Fourier Transform of these signals:

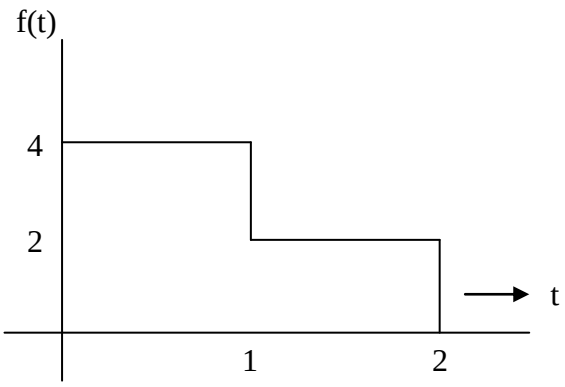
(i) $x(t) = sin\omega_0 t$

*Diberi

**Given*

$$FT\left\{\frac{e^{-j\omega_o t}}{2\pi}\right\} = \delta(\omega - \omega_0)$$

(ii)



Rajah 4(a)

Figure 4(a)

(30 markah/marks)

(b) Diberi dua isyarat iaitu;
Given two signals which are;

$$g_1(t) = 2\cos(200\pi t) \qquad g_2(t) = 5\cos(1000\pi t)$$

Hasil gandaan kedua-dua isyarat ini diberi sebagai;
The multiplication of these two signals is given by;

$$g_3(t) = g_1(t)g_2(t)$$

Dengan menggunakan ciri-ciri Jelmaan Fourier, cari :
By using appropriate properties of Fourier Transform, find:

(i) Jelmaan bagi $g_3(t)$
The Fourier Transform of $g_3(t)$

(ii) Lakarkan spektrum frekuensi $g_3(t)$.
Sketch the frequency spectrum of $g_3(t)$

(35 markah /*marks*)

(c) Pertimbangkan isyarat analog berikut:
Consider the analog signal:

$$x(t) = 5\cos(50\pi t) + 2\sin(200\pi t) - 2\cos(100\pi t)$$

(i) Tentukan nilai minimum frekuensi persampelan dan versi isyarat analog yang telah tersampel pada frekuensi tersebut.

Determine the minimum sampling frequency and the sampled version of analog signal at this frequency.

(ii) Lakarkan dan tunjukkan titik persampelan bagi setiap komponen isyarat analog.

Sketch and show the sampling points of each waveform analog components.

(35 markah /*marks*)

5. (a) Dengan menggunakan rajah, diagram dan persamaan-persamaan yang bersesuaian, terangkan:

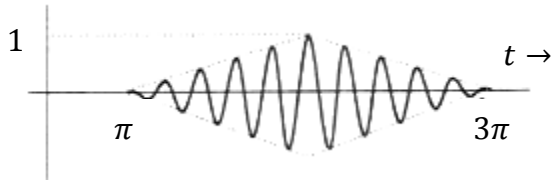
Using appropriate illustration, diagram and equations, describe:

(i) Kepentingan proses modulasi dalam proses transmisi data
The importance of modulation process in data transmission

(ii) Proses modulasi dan demodulasi
The modulation and demodulation process

(30 markah/marks)

(b) Isyarat dalam Rajah 5(b) ialah isyarat termodulat dengan pembawa cos 20t.
Signal in Fig. 5(b) is a modulated signal with carrier cos 20t.



Rajah 5(b)
Figure 5(b)

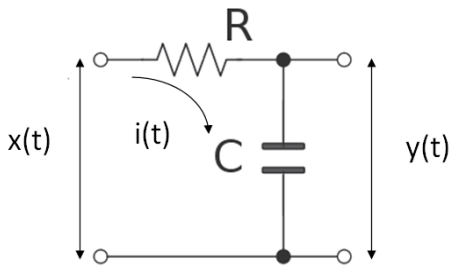
(i) Cari Jelmaan Fourier bagi isyarat termodulat seperti dalam Rajah 5(b).

Find the Fourier Transform for the modulated signal as illustrated in Figure 5(b)

(ii) Lakarkan spektra amplitud dan fasa bagi isyarat termodulat tersebut.
Sketch the amplitude and phase spectra for the modulated signal.

(30 markah/marks)

(c) Merujuk kepada litar RC mudah dalam Rajah 5(c):
Refer to a simple RC circuit as in Figure 5(c):



Rajah 5(c)
Figure 5(c)

Terbitkan dan buktikan bahawa persamaan asas bagi litar tersebut yang melibatkan x(t) dan y(t) diberi seperti berikut:

Derive and prove that the equation which relates x(t) and y(t) is as below:

$$\frac{dy(t)}{dt} + \frac{1}{RC}y(t) = \frac{1}{RC}x(t)$$

Dengan menggunakan Fourier Transform bagi persamaan di atas, tentukan:
By applying Fourier Transform to the above equation, determine:

(i) Frekuensi sambutan, H(ω)
The frequency response, H(ω)

(ii) Amplitud sambutan
The amplitude response

(iii) The phase response
Fasa sambutan

(40 markah/*marks*)

6. (a) (i) Cari jelmaan-Z bagi isyarat

Find the Z-transform of the signal

$$x(n) = \left(\frac{1}{2}\right)^n u(n) * \left(\frac{1}{3}\right)^n u(n)$$

(15 markah /marks)

(ii) Diberi fungsi seperti berikut,

Given a function as below,

$$X(z) = \frac{3 + 2z^{-1} + z^{-2}}{1 - 3z^{-1} + 2z^{-2}}$$

Cari jelmaan-Z songsang fungsi tersebut dan dapatkan empat ungkapan pertama bagi x[n]

Find the inverse Z-transform of the function using a power series expansion and find the first four terms of x[n]

(20 markah /marks)

(b) Dengan menggunakan jelmaan Z, tentukan sambutan sistem LTI dengan sambutan impuls h(n)= 0.4^n u(n) , dengan masukan, x(n)= 0.2^nu(n).

Using Z-transform, determine the response of the LTI system with impulse response h(n)= 0.4^n u(n) , for an input x(n)= 0.2^nu(n).

(25 markah /marks)

(c) Tentukan 4 titik DFT dan IDFT bagi isyarat berikut:

Determine the 4-point DFT and IDFT of the given signal:

$$x(n) = \begin{cases} 1 & 0 \le n \le 3 \\ 0 & \text{lain} - \text{lain}/elsewhere \end{cases}$$

Diberi:

Given:

$$F_r = \sum_{k=0}^{N-1} f_k e^{-jr\Omega k}$$

$$f_k = \frac{1}{N} \sum_{r=0}^{N-1} F_r e^{jr\Omega k}$$

(40 markah /marks)

oooOoooo